Tribus III. Retitelariæ.

Fam. 1. Scytodoidæ.
2. Pholcoidæ.
3. Theridioidæ.
&c.

Tribus IV. Orbitelariæ.

Cribellatæ.

Fam. 1. Dinopoidæ.
2. Miagrammopoidæ.
3. Uloboroidæ.

Ecribellatæ.

Fam. 4. Tetragnathoidæ.
5. Epeiroidæ.
6. Celænioidæ.
7. Cryptotheloidæ.
&c.

Tribus V. Laterigradæ.

Fam. 1. Heteropodoidæ.
2. Stephanopoidæ.
3. Thomisoidæ.
&c.

Tribus VI. Citigradæ.

Fam. 1. Lycosoidæ.
2. Oxyopoidæ.

Tribus VII. Saltigradæ.

Fam. 1. Attoidæ.

XXIX.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).*—No. IV. *On a Male Tunny* (Orcynus thynnus, *L.*). By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

[Plate XI.]

The specimen was captured on the 16th October, 1885, by one of the ships of the General Steam Fishing Company of Granton, when trawling in the "Fluke-hole" or Traith in the Forth, off Pittenweem, in 15 fathoms, and was most courteously sent to the Marine Laboratory and the University Museum by Mr. Scott, the manager, who states that the fish was dead when the trawl (which had been down about four hours) was brought on board. A powerful fish like this would probably make desperate efforts in the net; yet the stout fins, though

showing evidences of friction, were comparatively little affected, the tips of the pectorals and the caudal rays chiefly suffering. This immunity was probably due to their strength and to the fact that the strong spines of the first dorsal and the whalebone-like stiffness of the second dorsal and the anal only proved impediments and sources of rapid exhaustion to the entangled fish.

The specimen was of good size, weighing about $6\frac{3}{4}$ cwt., and having a total length of nearly 9 feet from tip to tip *. The greatest girth was 6 feet 5 inches, in a line with the second dorsal and slightly in front of the base of the anal. The circumference at the base of the caudal, again, was only 11 inches. The other measurements were:—

	ft.	in.
Length from tip of snout to base of tail	7	10
Length from tip of snout to anterior border of first dorsal	2	6
Length from tip of snout to anterior border of second dorsal	4	5
From tip of mandible to base of pectoral	2	2
From tip of mandible to margin of operculum	2	$3\frac{1}{2}$
Antero-posterior margin of gape (superiorly)	0	$7\frac{1}{2}$
Antero-posterior line to corner of maxilla	0	10
Vertical gape	0	8
Length of first dorsal	1	11
Height of first dorsal	0	$10\frac{1}{2}$
Length of second dorsal	0	9
Height of second dorsal along edge	1	$3\frac{1}{2}$
Base of pectoral	0	$4\frac{1}{2}$
Length of pectoral	1	5
Expanse near tip	0	9
Ventral, base to apex	0	$10\frac{1}{2}$
Anal, breadth at base	0	$6\frac{1}{2}$
Anal, base to apex	1	4
Expanse of caudal	2	10
Diameter of exposed region of eye, horizontal	0	$2\frac{3}{8}$
Diameter of exposed region of eye, vertical	0	$2\frac{1}{2}$

The colour of the dorsum was blackish, with hardly a tinge of bluish. The sides were greyish and the under surface white. No trace of stripes occurred in this example. The first dorsal had its spines black and the web dark brown; the second had its basal portion black and its apex yellowish. The pectorals were black, while the ventrals had the upper surface dark reddish brown and the under silvery, with brown between the rays; the edges were dark. The anal was silvery, with the anterior edge black. The finlets (accessory

* I have to acknowledge the aid kindly given me in measuring and note-taking by Mr. J. Wilson, Demonstrator of Zoology in the University.

fins), which were ten dorsally (the first, however, being appended to the base of the second dorsal) and nine (slightly larger) ventrally, had their bases reddish brown, shading off distally into bright yellow ; the free edge has a dark-fringed margin $\frac{3}{4}$ inch deep. The caudal had the upper half black, with the frayed portions pinkish; the lower half showed a large amount of red or pink amongst the black portions, probably from injury.

The chief points in external configuration that fall under notice are the scales and fins. The former, with the skin, constitute a dense coat of mail (corselet) in front, and must form a very efficient protection *. The first dorsal fin again is stated to have weak spines †; but it is sufficient in this specimen at least to point out that all are unbroken, while the tough membrane between them is lacerated, and that the powerful nature of the first spine is conspicuous. It is slightly grooved posteriorly for the second spine, and the whole fin can be folded into a hollow. There is likewise a flattened depression for the pectorals, and this gives an indication of the length of these organs when entire.

The external form of the tunny has been represented by various authors, and comparatively recently by Mr. Day, in his excellent work on 'British Fishes' ‡. The figures available for comparison, however, differ so much from the specimen under consideration that a special sketch, aided by a photograph, was made by Mr. Wilson, Demonstrator of Zoology, and will be published in the 'Fourth Annual Report of the Fishery Board for Scotland.' The premaxillary and maxillary region is too long in the figures of Cuvier and Valenciennes §, as as well as in Day's, in which the upper outline of the snout is also too uniform; and in these and in Yarrell's ‖ and Couch's ¶ figures the eye is too large. The mandibular region is too narrow and elongated in all the figures except Couch's and the upper margin is too straight in profile. The shading of the head in Day's figure gives a somewhat peculiar aspect to the lateral view of this region, which seems to be too long from the tip of the snout to the posterior margin of the operculum; and the same may be said of Cuvier and

* The minute structure of these scales has been investigated by Prof. Quekett.

† *Vide*, *e. g.*, Günther, Catalogue, ii. p. 362; Day, Brit. Fishes, p. 93.

‡ 'British Fishes,' ii. pl. xxxv. (1881). The earlier figures of Rondelet, Bélon, Salvien, Gesner, Duhamel, Bloch, and Pennant have been criticized by Cuvier and Valenciennes.

§ Hist. Nat. des Poissons (Paris, 1831), viii. pl. ccx.

‖ Brit. Fishes, 3rd edit. ii. p. 209.

¶ 'Fishes of the British Islands,' ii. pl. lxxxii.

Valenciennes's figure, the gape in both, moreover, being too long in its antero-posterior axis. The teeth are somewhat fancifully represented in all the figures, since they are much less distinct in nature. The spines of the dorsal fin are all of nearly equal thickness in the figure of the French authors and in Day's and Yarrell's, whereas, with the exception of the first, they are too thick in Couch's. They seem to have been unusually long anteriorly in the specimen figured by Day. The second dorsal fin has not been well represented in any of the figures, and it is much too broad and short in Couch's. The awkward flattening of the back along the base of the first dorsal fin in Day's figure is probably due to the taxidermist and is not found in nature or in the other outlines mentioned. The anal fin is also too short and broad in most of the figures, and Day's outline materially differs from nature in the relation of the second dorsal and anal fins to a vertical line. A line running vertically from the anterior margin of the anal falls behind the second dorsal; but in Day's figure it pierces the dorsal midway. The upper margin of the deep groove for the pectoral in a lateral view is generally seen above the somewhat straight edge of the pectoral; but this has not found its way into any representation. In none of these figures is the true shape of the finlets given, for in each a distinct elevation occurs in front and then a pointed process extends backward nearly parallel to the outline of the body; they are, in short, unequally bifid. The figure in Day's 'British Fishes' deviates considerably from life in this respect.

In the branchial chamber were numerous specimens of a *Caligus*, several examples bearing large tufts of *Obelia geniculata*, which seemed to flourish with remarkable vigour on so favourable a site. The hydrorhiza in some cases covers the ventral surface of the cephalothorax of the parasite with an intricate web of fibres, amongst which the feet can hardly be distinguished, while the dorsum of the same region is entirely shaded by a dense tuft of the polyparies, which are of great strength. In others the stolons spring from the abdominal region.

Digestive System.—The teeth appear proportionally small for so large a fish; they are slightly curved and turned inward and backward. A rasp-like surface occurs on the median hyoidean apparatus, and the sides of the tongue have a few horny processes. The mucous surface of the roof of the mouth has, in addition to the rasp-like teeth on the palatines, numerous hardened streaks from thin ossifications of the region.

The œsophagus is very short and wide, with muscular walls, and is deeply plicated longitudinally on the inner surface. It is about 8 inches in diameter at the cardiac end of the stomach. The surface near the latter is villous, but it is distinguished from the surface of the stomach by the greater number of rugæ in the latter.

The stomach is a large conical sac measuring 25 inches in length from the cardiac orifice to the apex posteriorly. Its inner surface is complexly rugose from longitudinal and transverse reticulations, and the contraction of the thick muscular mass in spirit considerably intensifies this feature. Externally the superficial muscular layer is chiefly longitudinal, then follows a series of circular fibres; while internally a layer apparently of interwoven fibres occurs, with much connective tissue. The whole forms a powerful muscular chamber, in which were three haddocks (11, 11, and 9 inches respectively), two lemon-dabs (9¼ and 8¼ inches), and two common dabs (each 7½ inches). While searching for these at the bottom of the water it had encountered the trawl-net. The pyloric region of the organ is situated about 3 inches from the cardiac opening and therefore near the œsophagus. The walls of the diverticulum leading to the pyloric valve are rugose and remarkably massive, especially at the termination, near which one large boss projects from the posterior wall of the canal. These thick folds form a very efficient valve, which arrests even small bones, such as the vertebræ of the haddocks and dabs, and in all probability peristaltic action sends them out of the mouth if bulky *, or they remain there till the gastric secretion disintegrates them.

At the cardiac end of the stomach were five examples of a large *Distomum*, apparently *D. clavatum*, Rud., a species which has been found in the stomach of *Pelamys sarda* and in the intestine of *Coryphæna hippurus* in the Mediterranean, as well as in the present form †. Amongst the mucus of the same organ were a large *Ascaris* (imperfect), two *Echinorhynchi*, probably from the haddocks or other prey, and a fragment of a mollusk from the same source.

The calibre of the duodenum at its commencement is comparatively small, and externally the distinction between the two regions is well marked on palpation. Beyond the prominent boss at the pyloric valve are a few longitudinal and oblique ridges of the canal; but these soon cease, and the proper duodenal region of the gut is smooth, with the excep-

* A common occurrence in fishes.

† Carus, 'Prodromus Faun. Mediter.' i. p. 131.

tion of faint longitudinal elevations. It is about 7 inches in length.

About half an inch behind the pylorus the thick wall of the duodenum is perforated by the comparatively small aperture of the gall-duct. On close examination the opening at the bottom of the pit, however, is found to be double. One aperture leads almost directly into a cæcal appendix nearly 3 inches in length, placed anteriorly close to the hepatic duct; while another, more oblique in direction, leads into the latter. Commencing next the gut, the narrow gall-duct shows a dilatation about half an inch in diameter about 2 inches from its origin. It again contracts after a course of 5 inches, and then dilates into a long sac of unequal calibre—2 feet 4 inches in length, besides a terminal appendix $1\frac{1}{2}$ inch long. The remarkable length of the organ was even noticed by Aristotle. Three dilatations occur in the long sac, viz. a fusiform one 6 inches in length inferiorly, another, of the same shape, 12 inches long, and a more cylindrical terminal region, which also shows, however, a slight dilatation in the middle and an approach to a diverticulum at its commencement. Slightly contracted regions separate these divisions from each other. The bile has a dark green colour and is aqueous. The cæcal appendix is somewhat wider than the gall-duct at its base, dilates rapidly to almost double the diameter, and then diminishes to a conical apex. The walls of this cystic appendix are thinner than those of the duct, and the inner (mucous) surface is minutely speckled with blackish or dark brownish pigment-points. The gall-bladder again shows terminally a beak-like diverticulum of a conical form, which projects from the longitudinal axis of the organ at an angle. The inner surface is apparently smooth, though marked with minute black points, as in the foregoing sac, and the wall is comparatively thin. Under a lens a tendency to minute reticulation, however, is observed even in the distal region of the bladder, and after a course of from 15 to 18 inches down the organ such becomes more pronounced, and the wall at the same time increases in thickness. The latter is especially marked at the commencement of the dilatation, measuring 6 inches in length, for the wall is denser than that of the 12-inch distal dilatation. Where the 6-inch region contracts inferiorly prominent longitudinal rugæ appear and frequently run together, the intermediate spaces being finely reticulated. The reticulations are less pronounced in the narrow portion between this and the nearly cylindrical region (about 3 inches in length) inferiorly. The latter is marked throughout by longitudinal

ridges, which frequently run together, the intermediate surface being minutely reticulated. The ridges and reticulations keep the character just noted till within 4 inches of the gut, where the wall becomes denser, partly from the great development of the longitudinal ridges, which resemble folds like those of the "manyplies," so that only fluid will readily pass along. Under a lens the surface is still reticulated, but more minutely. These rugæ continue, in the forward course of the canal, through the wall of the gut to its termination in the pit. Thus the differences between the lining membrane of the gall-bladder, its duct, and the cystic appendix are marked, though the minute black specks are everywhere present.

Into the duodenum, which has about the same calibre as the rest of the gut, seven (Cuvier and Valenciennes say five *) large ducts enter from the great glandular pyloric mass. the cæca of which are about a line and a half in diameter. The first of these (having a diameter of half an inch) joins the canal about an inch from the pylorus; it consists of a main stem an inch in length, which splits dichotomously into a number of branches, each of which resolves itself into a carrier for a bundle of the ultimate cæca, fat, and connective tissue, forming a terminal process of about 3 inches in length. The second main duct enters the duodenum close to the foregoing, and it has a similar diameter, though the stem reaches the length of 3 inches. The chief branches are also much longer, so that the terminal cæca extend outwards about a foot from the gut, and thus permit a ready disposition of the parts in the abdomen. Further, the smaller branches are for the most part disposed on one side of the larger, so as to give a fan-like arrangement when they are stretched on a flat surface. The third is a short trunk (placed about half an inch from the second), which quickly divides into a large number of branches to the cæca, which thus approach the gut proximally (within $1\frac{1}{4}$ inch), but are nearly 3 inches distant terminally. The fourth duct is fully $\frac{3}{4}$ inch in diameter, and enters the duodenum about $1\frac{3}{4}$ inch further backward. After a short course of $\frac{3}{4}$ inch it breaks up into a number of branches, which chiefly spring from the anterior region. The fifth is an inch behind the preceding, and consists of a short wide tube (1 inch in diameter), which splits into a fan-like series of branches, the cæca being near the gut. The sixth (1 inch distant from the fifth) and the seventh ($1\frac{1}{2}$ inch behind the sixth) have similar short trunks with a fan-like distribution of their branches, the ultimate cæca in the latter being considerably shorter than in front.

* *Op. cit.* vol. viii. p. 65.

On the whole, the second duct is that which appears to have the largest collection of cæca, the first and fourth following next in order, and thereafter the fifth, sixth, third, and seventh respectively. In the interior of the ducts is a reddish gelatinous substance, which presents a granular structure with numerous oil-globules and opaque fatty concretions of a rounded shape.

The great mass of the pyloric cæca presents a cordate outline, the intestine entering the centre. It is 13 inches across the base, and from the latter to the apex measures 20 inches. It is invested by peritoneum, the edges of which show crenations, and in certain parts fimbriæ.

The intestine measures 5 feet from the end of the duodenum to the rectum. The entire surface is covered with a downy coat of villi about $\frac{1}{5}$ inch in length. No food was present amongst the masses of tough mucus. The peritoneal surface of the intestine and gall-bladder presents numerous black pigment-streaks and patches. The villi of the rectum were covered with bloody mucus. The diameter of the canal is nearly uniform.

One of the most interesting features in connexion with the liver and its vascular supply is the presence of the remarkable "Wundernetze" so ably described by Eschricht and Müller *. Four conspicuous examples of these occur in the hollow of the liver, along the wall of the stomach, just behind the œsophagus, besides some minor spindle-shaped processes, and at first sight their consistence and colour might readily cause them to be mistaken for splenic tissue. The first measures $3\frac{1}{2}$ by $2\frac{1}{2}$ inches, the second $4\frac{3}{4}$ by $2\frac{1}{4}$ inches, the third $5\frac{1}{2}$ by 3 inches at the widest part, and the fourth $2\frac{1}{2}$ by $1\frac{1}{2}$ inches. All are of a deep reddish colour, somewhat reniform in outline and present similar structure. Large blood-vessels, chiefly connected with the hepatic artery, enter them and split up into a closely arranged series of parallel vessels, so that the organs assume a fibrous appearance, and readily tear in the direction of the parallel vessels from edge to edge. In this instance the splitting was transverse or slightly oblique with regard to the long axis. In the smallest, on the other hand, the fibres ran in the direction of the latter. On examining a thin transverse section (*i. e.* across the long axis of the fibres and tubes) under a lens a closely arranged series of reticulations present themselves, a larger and a smaller being especially conspicuous (Pl. XI. fig. 1), this variation

* "Ueber die arteriösen und venösen Wundernetze an der Leber und einen merkwürdigen Bau dieses Organes beim Thunfische," Abhandl. der k. Akad. d. Wissenschaften zu Berlin, 1835, p. 1 &c.

being apparently due, in many cases, to the condition of the vessels as regards distention by blood. The vessels have a delicate translucent lining, apparently epithelial, and the muscular or elastic wall, chiefly composed of circular fibres, is of great thickness, and generally tinged reddish by the hæmoglobin. The vascular channels are bound together by granular connective tissue and cells, and it is this which gives way when the structure is torn longitudinally.

The size of the vascular channels is such that a large amount of blood must pass quickly through these organs.

The liver forms a large trilobate mass of a greyish-yellow colour. It has been described both by Cuvier and Valenciennes*, and by Eschricht and Müller†, the latter authors likewise giving very good figures of it. The margins in the present example show various lobules which range from ½ inch to 3 inches in length.

The spleen forms a great glandular organ of a dull reddish colour attached to the intestine behind the duodenum, and measures 22 inches in length by about 3 in diameter. It is firm and rather friable, somewhat resembling a fatty liver in section, the surface of the latter being dotted with large reddish-brown masses and more minute intermediate blackish specks. Microscopically it presents a uniform matrix of a minutely cellular appearance. The organ appears to have undergone considerable degeneration.

The male reproductive organs are attached to huge flattened fatty folds fully an inch in thickness, which occupy the posterior region of the abdominal cavity. Towards their anterior ends these folds are highly vascular, so that in minute structure the tips for a distance of 6 inches resemble that of a blood-gland, and they are of a deep red colour. The rest of the folds are fatty. Two or three minute ova, apparently parasitic, occurred in the dissection of these masses. The reproductive organs are separated from these folds by no distinct line of demarcation, but are closely connected with their outer borders. The organs measured respectively 2 feet and 1 foot 10 inches in length, by 3½ and 3 inches in breadth. In a transverse section through both parts it is easy to distinguish the more compact tissue of the reproductive organs; but the inner border of the fatty folds sends fibres and vessels into the reproductive organs, so that they are more or less continuous with each other. In minute structure they present a series of closely arranged transverse tubular folds. No sexual products are visible. The urinary bladder is a thick muscular organ of small dimensions.

* *Op. cit.* p. 66.

† Abhandl. Akad. Berl. 1835, p. 2 *et seq.* Taf. i., ii., u. iii.

The ventricle of the heart forms a great muscular triangle nearly 6 inches in its longer boundary, such as at the base or along the convex edge. This powerful muscular mass contains a comparatively small chamber which has an apical and two lateral diverticula besides the great channel into the bulbus. Each of these has various pits in the muscular walls. The external layers have their fibres mostly in the long axis of the sides, so that they are thus differentiated from the more transversely arranged inner region. The aperture into the bulbus is defended by the two great valves, and its whole inner surface is thrown into a somewhat symmetrically arranged series of elastic pouches, which by their disposition probably perform some of the functions of the Elasmobranch *conus*, since their posterior folds (Pl. XI. fig. 2, *a*, *a*) apparently form pockets in action. A similar condition is present in the swordfish, as represented by Dr. Günther*.

The auricle is a large and comparatively thick muscular chamber with a complex network of *musculi pectinati* scattered over the surface.

The large quantity of the circulatory fluid in this fish was very marked, especially as it remained fluid. The appearance of the muscles and other parts renders it probable that the species would afford interesting results in regard to temperature-observations. This is the more likely since Dr. John Davy found the temperature of the blood in the deep-seated muscles a little below (?) the gills in the bonito (*Thynnus pelamys*, Cuv. & Val.) to be 99° F., whereas the temperature of the surface of the water was in the region 80°·5 †.

The swim-bladder is 3 feet in length and upwards of a foot in diameter at its widest part. It has been briefly alluded to by A. W. Malm in his account of a specimen from the Skagerak ‡; but its interesting structure merits further study. In the abdominal cavity the organ is situated close above the intestine and other viscera, since the enormous subvertebral muscular masses occupy the dorsal region and considerably limit the space for its distention. Externally it has a peritoneal coat on its free surface. Internally the whole surface is beautifully reticulated by a vast series of raised whitish bands which inosculate with each other. The main series of these springs from the circumference of a large aperture (Pl. XI. fig. 3, *a*) an inch and a quarter in transverse diameter and an inch and a half in antero-posterior diameter, which seems to occupy the mid-dorsal region. The aperture, which is mentioned by Malm, is surrounded by a few warty processes,

* Introd. Study of Fishes, p. 152, fig. 68.
† Edinb. New Phil. Journ. vol. xix. p. 325.
‡ Göteborgs och Bohusläns Fauna, 1877, p. 415.

and leads into a large subperitoneal space. These bands spread in a radiate manner into the surrounding area, inosculating with each other early in their course, and by-and-by forming meshes (Pl. XI. fig. 4) all over the surface. The ribs of the meshes are especially strong in front, and most of the large meshes also occur in this region. Moreover, here and there certain thickenings of the elastic ribs occur, forming small solid nodes. As shown in the sketch (fig. 4) the larger meshes in front have their long axis antero-posterior, and each has either a central longitudinal rib with lateral bars, as in a leaf with its midrib, or numerous strong ribs bind the sides of the long meshes transversely. There is indeed great variety in regard to the arrangement of the central ribs and veins, but the whole presents an elaborate and sometimes a nearly regular series of reticulations. The latter closely approach the great aperture of the sac posteriorly, as indicated in the sketch (fig. 3). The general aspect of the inner surface of the air-bladder is thus less silvery than in many fishes, apparently from the predominance of the lustreless whitish ribs, and indeed is more evident on the outer surface of the ribs after the superficial fibres are removed. The raised ribs appear structurally to be modifications of the elastic tissue usually found in such organs.

The object of these varied reticulations and of the solid, firm, and elastic ribs is apparently to increase the strength of the huge air-sac without adding much to its bulk, while at the same time very great elasticity is provided for. The morphologist is likewise reminded by the leaf-like enclosed areas of the further development of the principle as observed in the lung-like organs of the Dipnoi.

When removing the muscles of the dorsum a tumour resembling a pheasant's egg in size and shape was found. It is solid and firm, presenting on section a border of blackish pigment and a whitish centre. Microscopically it is fibro-granular with many oil-globules, and the pigment is either in masses or scattered thinly in stellate corpuscles.

Note.—In my paper in the 'Annals' for June 1885, p. 433, line 1, *for* bubalis, *Bloch*, *read* scorpius, *L.*

EXPLANATION OF PLATE XI.

Fig. 1. Section across the long axis of a vascular *rete*. *a*, cavity of a great vessel; *b*, muscular (and elastic?) wall of the same; *c*, mass of blood-corpuscles; *d*, connective tissue. × 90 diam.

Fig. 2. Heart of the tunny reduced to somewhat less than half-size, and opened from the dorsal aspect. *a*, *a*, pouches in the *bulbus*

aortæ; *b*, the two aortic valves; *c*, remnant of the auricle; *d*, cavity of the ventricle, showing various diverticula. The great muscular walls are kept apart by a style.

Fig. 3. The aperture (*a*) of the air-bladder, with its neighbouring reticulations and radii. Considerably reduced.

Fig. 4. A few of the reticulations on the inner surface of the anterior region of the swim-bladder. Natural size.

XXX.—*Notes on the Palæozoic Bivalved Entomostraca.*—No. XX. *On the Genus* Beyrichia *and some new Species* *.

By Prof. T. Rupert Jones, F.R.S., and Dr. H. B. Holl, F.G.S.

[Plate XII. †]

Contents.

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* For No. XIX. see Ann. & Mag. Nat. Hist. for March 1885, p. 174.

† This Plate has been drawn under a grant from the Royal Society for the illustration of fossil Ostracoda.